DISCRETE DISLOCATION PLASTICITY AND NONLOCAL CONTINUUM PREDICTIONS FOR TENSION AND BENDING

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Plane strain tension and bending of a strip is analyzed using discrete dislocation plasticity where dislocations are represented by their elastic singular fields which directly account for the long range interactions between dislocations. Short range interactions are accounted for through a set of constitutive rules that accounts for line tension and dynamic source and obstacle creation in addition to rules that account for a static set of initial point sources and obstacles. The bending analyses are qualitatively compared with predictions based on the nonlocal crystal plasticity theory of Gurtin. In tension, calculations are carried out to strains of 3% to 8% and the transition from stage I to stage II hardening is exhibited. The dependence of this transition and of the stage II hardening on constitutive parameters is explored. A variety of stress-strain responses are obtained and compared with available experimental results. The emergence of dislocation cells is seen and the structure of the cells is described.